FUTURE WAR AT SEA

DECLINE OF HUMAN DECISION-MAKING IN NAVAL OPERATIONS?

Wars are fought by the humans. The human element is the most important element of warfare in general, and war at sea was not in the past and will not be in the future an exception. The basic requirements for success in combat are the naval commander's understanding of the capabilities and limitations of the human nature. Materiel represents the means not the ends in naval warfare. Human nature has changed little despite the vast changes in naval technologies. However, within limitations discussed, support by machines can enhance the decision-making process.

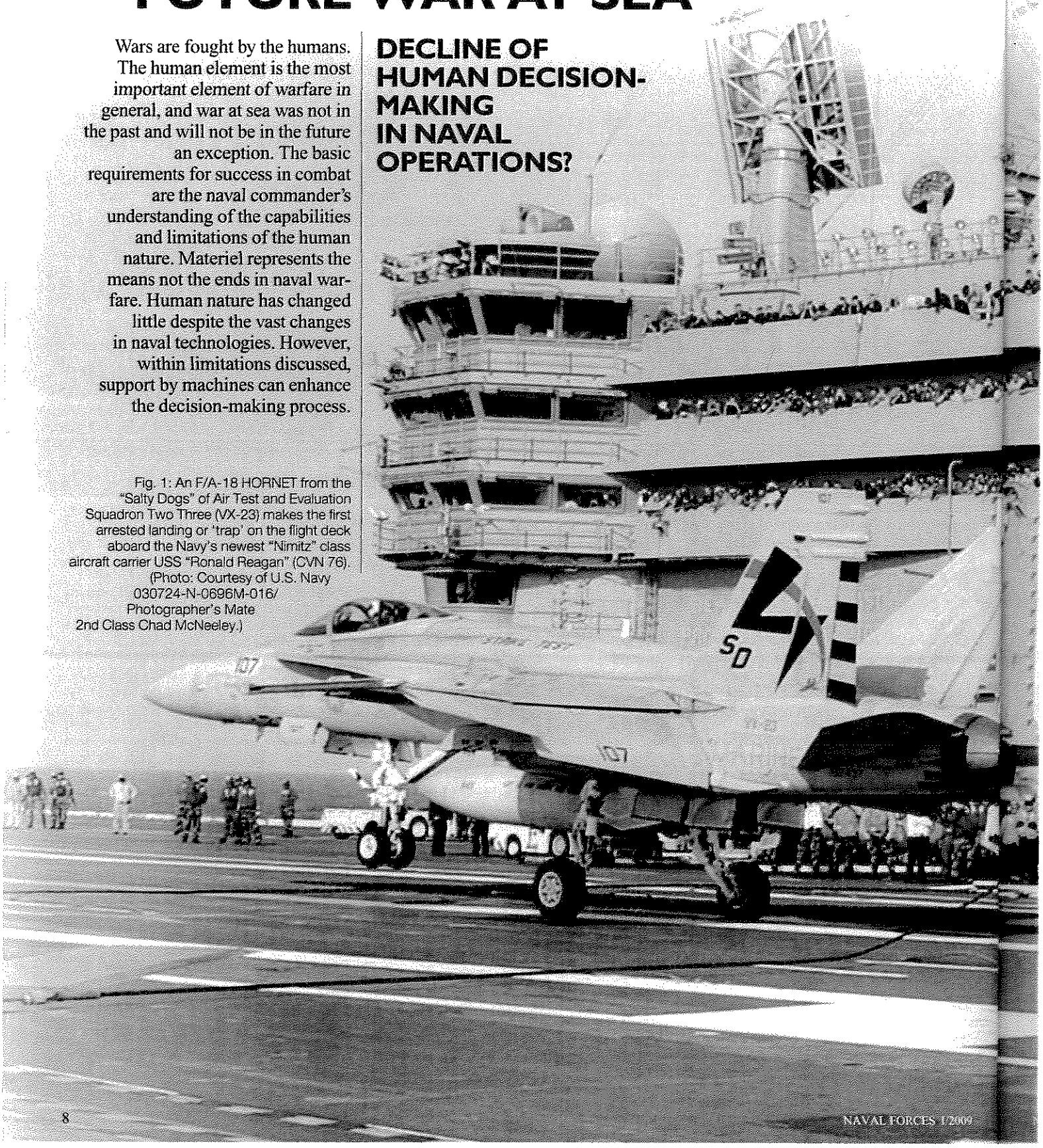

Fig. 1: An F/A-18 HORNET from the "Salty Dogs" of Air Test and Evaluation Squadron Two Three (VX-23) makes the first arrested landing or 'trap' on the flight deck aboard the Navy's newest "Nimitz" class aircraft carrier USS "Ronald Reagan" (CVN 76). (Photo: Courtesy of U.S. Navy 030724-N-0696M-016/ Photographer's Mate 2nd Class Chad McNeeley.)

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THE HUMAN FACTOR VERSUS TECHNOLOGY

Today, many theoreticians and operators apparently believe that the new and emerging naval technologies will drastically change the nature of war at sea. Supposedly, one's forces would be able to identify virtually everything of importance, in real time, in any kind of weather, at any time. One's naval forces would be capable of long-range, lethal and precise fires against the targets at sea, ashore and deep inland. Current trend, especially in the U.S. Navy is toward an ever-increasing reliance on various unmanned aerial and undersea vehicles (UAV/UUV). This is especially the case in mine counter measures (MCM), anti-submarine warfare (ASW) and surveillance/reconnaissance (SR).

Experience shows, however, that new technological advances changed the methods of one's combat force employment but not the very nature of war. Neither did the advent of steam propulsion, combustion engines, electric telegraph, undersea cable, mines, torpedoes, wireless radio, submarines, aircraft, nor missiles change the essential nature of war at sea. What did change is the character of war at sea and methods of combat employment of one's naval forces.

The future will not be that much different in that respect than it was in the past. In fact,

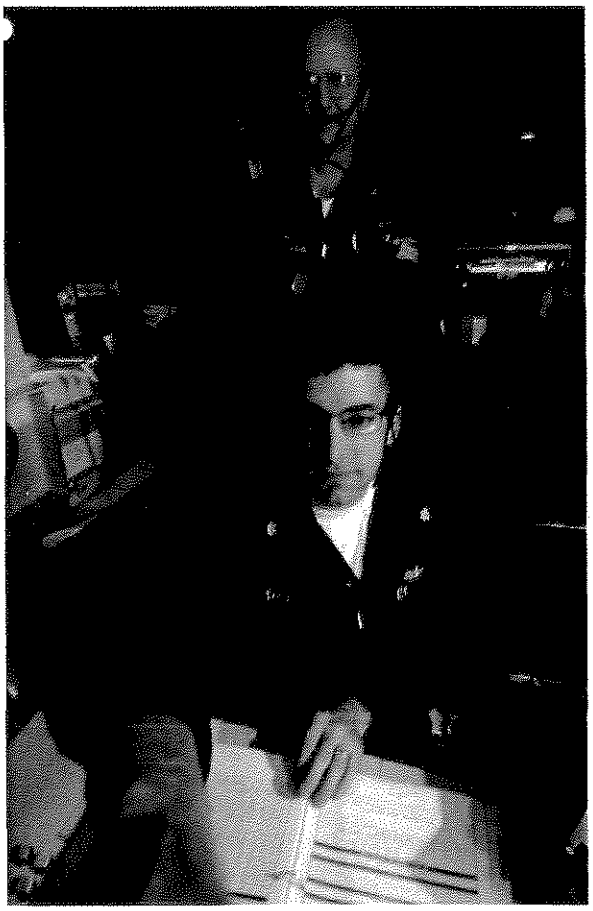

Fig. 2: Capt. Randall Hendrickson, commanding officer of the "Ticonderoga" class guided-missile cruiser USS "Lake Erie" (CG 70), in the combat information centre – surrounded by high-tech in the end it is he who has to make the final decisions. (Photo: Courtesy of U.S. Navy 080216-N-5476H-061 / Mass Communication Specialist 2nd Class Michael Hight)

the advent of any radically new naval technological development in the past led many observers to believe that it would make all technologies essentially obsolete. And in each instance, whether it was the introduction of some new naval platform or weapon system, the changes in the conduct of war were far less than the weapon's proponents had predicted.

Blue-water navies and the U.S. Navy in particular, have apparently almost boundless faith in the value and importance of new technologies. In the process, the human element of warfare is grossly neglected or even ignored. Proliferation and wide use of technology-related terms such as self-synchronisation and human-centric are proof to what extent technology and also tactics dominate thinking in today's navies. For instance, the U.S. Navy's FORCEnet is defined as the operational construct and architectural framework for naval warfare in the information age, which integrates warriors, sensors, networks, command and control (C2), platforms, and weapons into a networked, distributed combat force, scalable across the spectrum of conflict from seabed to space and sea to land.[1] FORCEnet is also defined as a strategic conceptual effort intended to capture all aspects of network centric operation and serve as the U.S. Navy's part of the global information grid. It links sensors, weapons, C2, and people to other Navy and joint forces. FORCEnet combines information, weapons systems and units to effect rapid and decisive action. It serves as the organising principle for the Navy's evolving doctrine for network-centric operations.[2] One would think that FORCEnet is a system that supports decision-making by the naval commanders. It should also not include C2 because the latter is not a technical system but a process fully designed and controlled by the humans. More accurate definition of the FORCEnet is the Navy-wide system linking platforms, weapons/sensors and networks used in support of command and control process.

THE COMMANDERS

The key elements in the decision-making and planning process are the commanders and their staffs. However, the commander by virtue of his or her authority and responsibilities must be solely responsible for all decisions pertaining to combat employment of subordinate naval forces. That responsibility cannot be delegated to the Chief of Staff or someone in the staff. Moreover, the commander's responsibilities cannot be relinquished to automated decision aids regardless of how advanced they are. Among other things, only the commander has the ability to reduce the complexities of the situation to its essential elements, estimate the situation and then make a quick and sound decision. This implies foresight and an imagination that can see all the advantages, all the chances, all the obstacles, in their true proportion and then make a firm decision what needs to be done. A naval commander must have sound judgment which is the result of logic and common sense. He must exercise the initiative in carrying out his assigned mission. Optimally, the naval commander should conduct a quick estimate of the situation, adopt a sound course of action, and execute it promptly and decisively. Speed is usually far more important than precision in making a decision. Generally, a good plan executed quickly is usually better than a superb plan executed late.[3]

The highest art of a naval commander at any level of command is making timely and sound decisions. The decision provides the basis for the subsequent development of the operation plan or order. The act of exercising command consists of making decisions and ordering their execution.[4] The most important factors in making a decision should be the mission and the military situation. The decision can also be based on the task or tasks derived in the course of the decision's execution. Actions conducted on one's own initiative also require a new decision.[5]

Because maritime campaigns and major naval operations are conducted over a much larger area and involve considerably larger and more diverse forces than tactical actions, the naval operational commander should evaluate the situation in all its complexity several weeks or even months ahead – followed by a 'running estimate of the situation'. However, the resultant decision will be often made on incomplete and false information and in a time-space window that is very different from that of the tactical commander. The decisions by the naval operational commander are more likely hypotheses; because they are based on courses of action developed using many assumptions.

In contrast to tactical commanders, naval operational commanders have generally more time to make decisions. Because of steadily compressed time-space relationships, not only operational decisions must be made within the short time window, but their impact will almost immediately affect the actions of friendly forces over a major part of a given theatre. Often the commander must base his decisions on his own instinctive judgment and without benefit of a careful analysis of the situation, weighing the advantages and disadvantages of each alternative course of action.

The number and importance of the decisions to be made varies for each level of war. In general, the higher the level of war, the fewer the decisions that must be made and the larger the time window is for making them. Naval operational commanders make fewer decisions, but the impact of these decisions is much greater than that of those made at the tactical level. The key for making sound operational decisions is to have an accurate picture of the operational situation. This cannot be obtained by simply collecting vast amounts of tactical data or informa-

tion. The operational situation should be built as a synthesis of strategic and tactical information pertaining to the naval operational commander's area of responsibility plus his area of interest. It deals with both military and non-military aspects of the situation. The naval operational commander should also make his decisions by fully taking into account the trends in the operational situation several weeks or even months into the future. In contrast, the tactical commander is concerned with the developments of the tactical situation, from a few hours to several days ahead.

DECISION-MAKING PROCESS

The C2 process in littoral warfare is more challenging then in war on the open ocean. Because of the small size of the area and high intensity of action on both sides, changes in the tactical and operational situation will be rather sudden and drastic. This implies that the C2 process should generally be highly decentralised, giving large freedom of action to subordinate tactical commanders.

Network-centric warfare (NCW) advocates claim that new technologies would further compress and greatly speed up the decision cycles for commanders at all levels. This, in turn, would significantly accelerate the tempo of fighting, requiring more decentralised decision-making. Decision cycles for commanders at all levels would be further compressed and greatly shortened. This, in turn, would significantly accelerate the tempo of fighting and require more decentralised decision-making.

However, highly integrative technologies and information gathering may create a false belief that centralised decision making will result in greater effectiveness. Such a trend needs to be avoided, because highly centralised C2 invariably restricts the freedom of action of operational commanders and their subordinate tactical commanders. An increase in information volume has historically been best resolved through *decentralised*, not centralized C2.

NCW proponents argue that one's ability to operate well within the enemy's decision cycle would enable to make decisions more quickly and supposedly also more precisely.[6] A combination of quick decision making and diverse high-precision weapons launched by geographically dispersed forces would enhance the probability of achieving a first-round hit on a target.[7]

However, one's decision superiority is not necessarily a result of information dominance. To make faster and sounder decisions, it is necessary to have properly educated and trained forces and a sound command structure and doctrine. Some NCW proponents contend that in a networked force, C2 will not ultimately be the sole responsibility of any single individual. Instead, it would be shared, distributed and a collaborative responsibility and this distribution and devolution of authority would require change to command concepts and doctrine.[8] However, the experience convincingly shows the falsity of exercising C2 by a committee. Optimally, unity of effort through unity of command can be achieved only by having a single commander responsible for planning, preparing and controlling naval forces in combat.

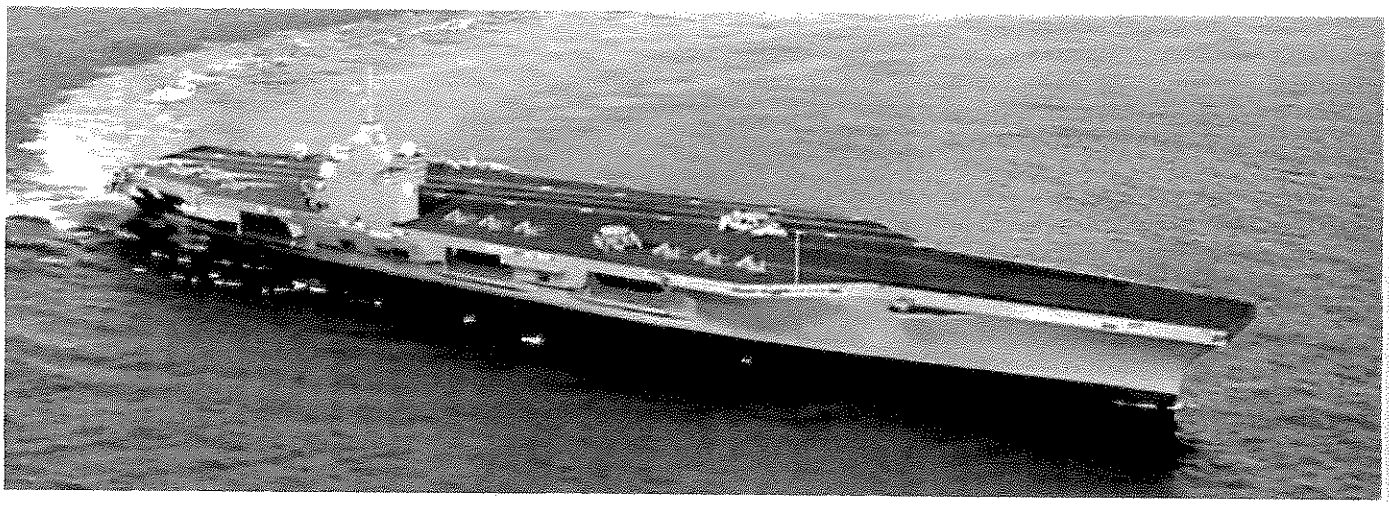

Fig. 3: A modern warship like the aircraft carrier USS "Gerald R. Ford" is full of electronics to support all operations. But no computer can replace the Commanding Officer who in the end has to make the decisions in combat. (Photo: Courtesy US Navy)

COMMON OPERATING PICTURE

One of the benefits of the new information technologies is the possibility of creating what is called a 'common operating picture' (COP). This is achieved by using advanced sensors, powerful computer networks, improved display technology, and sophisticated modelling and simulation. Information from all sensors is available to all net participants. The air picture displays the tracks of enemy, friendly and neutral aircraft, cruise missiles, and ballistic missiles. The picture of the surface situation contains tracks of warships, commercial shipping, fishing vessels and pleasure boats. The undersea situation pertains to the location and movement of hostile submarines and location of mines.[9] All three components of the COP are much more complex in the littorals compared to those on the open ocean. In the littorals, the problem is compounded by the need to collect and analyse the enemy, friendly, and neutral situation on the ground not only on the coastline but many hundreds of miles inland.

At the tactical level, a COP is achievable because the tactical situation, while highly dynamic, is also much less complex than at the higher levels of war. However, at the operational level of war, tactical information must be processed and synthesised to provide an operational picture of the situation. In general, the higher the level of command, the greater the importance of unquantifiable or intangible elements of the situation. Obviously, these elements cannot be obtained by using technical means of information collection. In contrast, naval tactical commanders are normally concerned with purely physical aspects of the situation in their respective combat zone or sector. There is also a tension between the sender's perception of reality and the receiver's personal understanding. So-called 'shared awareness' does not necessarily mean 'shared understanding'. By ignoring the human dimensions of warfare, network-centric warfare advocates underestimate the human capacity to deal with contradictory information.[10]

Having a COP would most likely lead many operational commanders to be increasingly involved in purely tactical aspects of the situation and in making tactical decisions, instead of focusing on the operational and strategic aspects of the situation within their respective areas of responsibility. At the same time, naval tactical commanders could easily be distracted by the operational or even strategic aspects of the situation instead of paying the necessary attention to their responsibilities as tactical commanders. The solution to these and similar problems is that each commander should have as complete a picture as possible of the situation within his area of responsibility and of the key elements of the situation in his areas of interest. This, in turn, argues against flattening the command organisation, but in favour of having intermediate levels of command with associated intelligence organisations.

AUTOMATED DECISION AIDS

The increasing use of various automated systems in support of the decision-making process is the result of the ever increasing complexity of the operational environment and the missions to be carried out by one's naval forces. Automation refers to the mechanisation and integration of the sensing of environmental variables, data processing and computer-assisted decision-making.

The humans can reason inductively and generate conceptual representations based on both abstract and factual information. Unlike computers, they have the ability to optimise based on qualitative and quantitative information. By relying on the human brain both the humans and automated systems can respond more flexibly to uncertain and unexpected events.

The problem of information overload can be potentially resolved by increasing the automation level. Advanced computers can be used for filtering and synthesising data to provide naval commanders with recommended solutions. However, it is usually very difficult to include every single variable or their combinations into a computer algorithm.[11] Normally, a naval commander should rely on an automated system in order to maximise gains and minimise potential losses. The failure to heed warnings generated by automated aids can well result in a disaster. The other extreme, over-reliance on automation can lead to complacency and in an uncritical acceptance or giving too large a role to computer-generated recommendations in the commander's decision-making.[12]

Automation also has great importance in planning. Advanced computers are capable of solving the allocation of one's forces and assets and phasing in of one's forces to a given theatre. However, their use in planning is limited because they cannot envisage all the potential conditions or relevant factors. To complicate the matter further, the complexity of the situation might cause the humans not to understand fully how missing information or variables and their combinations affect the computer-generated

solution. The inability of the humans to understand complexities of algorithms would exacerbate the humans' propensity towards automation bias.[13]

The levels of automation can range from the situation where the humans make all the decisions without any assistance from computers to the one where computers operate autonomously and decide everything. In the intermediate automation levels, computers might offer the entire set of courses of action or narrow down to a few courses, suggest an alternative and execute it if the human approves it; or computers can allow the human a certain time for making a final decision, or they can execute the action automatically and the inform the humans or inform them only if asked or if computers decide to do so.[14]

Despite the enormous capabilities of modern computers, the humans still play the key role in decision-making. The problem is finding a proper balance between automated and manual control. Dismissing or ignoring benefits of automation would result in the disuse of automation while an overreliance on automation would lead to its misuse. The optimal solution is to find a middle ground between relying on the humans and automated decision aids in making decisions.

Fig. 4: It does not show here, but Captain Frazer, the Commanding Officer of the aircraft carrier HMS "Illustrious" here on the bridge of his ship can be a very 'lonely' person when it comes to decision making. (Photo: Courtesy of Royal Navy / UK MoD)

In general, the humans perform better than computers in the perception of patterns, using flexible procedures, making ad hoc decisions, recalling relevant facts at the appropriate time ('running estimate of the situation'), in using inductive thinking and exercising judgment. Computers are much better than humans in responding quickly to control tasks, performing repetitive tasks, deductive reasoning, and carrying multiple and diverse task simultaneously. The humans are generally effective in resolving ill-structured problems under stress. However, they are liable to fallible trial-and-error problem solving. The humans usually seek information

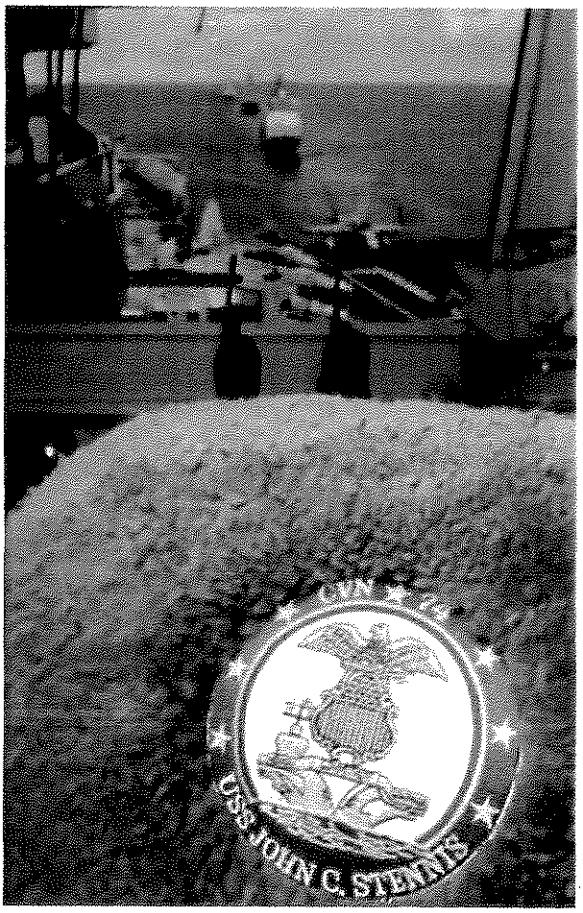

Fig. 5: In the end, it is the Commanding Officer sitting in his chair (here that of the "Nimitz" class aircraft carrier USS "John C. Stennis") who has to decide what can determine the success of his mission. (Photo: Courtesy of US Navy)

in order to confirm a prior belief. They often discount information that does not support their biases and predilections. The humans tend to assimilate new information although it contradicts their pre-existing mental model. They also do not search for contradictory information and might accept a computer-generated solution. Another potential source of the human errors in C2 of naval forces is so-called automation bias. Errors of omission occur if the humans do not recognise the errors because the automation does not alert them. Errors of omission happen when the humans erroneously follow computer-generated recommendations or directives.[15]

Generally, highly automated C2 is applicable for a situation which requires simple decisions and where the probability of system failure is low. However, reliance on highly automated systems for making decisions in a fast moving and very complex situation is not usually advisable. The main reason is that the human brain is far more adaptable to fast changes in the situation and unanticipated events. Automated decisions are also highly unreliable.[16]

The level of reliance on automated decision aids is also largely dependent on the level of command. In general, the less frequent changes of the situation are and the more time is available for making the decisions, the more effective is reliance on highly automated systems. Despite great advances in information technologies over the past two decades, the time required for sensors to respond to the tactical commander's tasking is still too long. Naval tactical commanders and theirs staff receive vast amounts of information from the national strategic and theatre commanders in addition to information acquired by own sensors and other tactical commanders. However, naval tactical commanders do not have either the time or the tools to timely and properly digest, interpret and recognise the relevance of information.

Hence, it is actually the operational level of command and not the tactical level where highly automated decision aids might be more effective. However, the problem is that most of the navies are too much focused on tactics and technology while the operational level of war is given a short shrift or even not understood. For example, in the U.S. Navy, the levels of command are all too often confused with the levels of war although they are two different things. There is also a false belief that if C4ISR can support tactical execution then it can also support the operational-level planning.[17] It is apparently forgotten that the naval operational commander requires a fusion of strategic and tactical intelligence to create operational picture in support of planning and execution of major naval operations.

CONCLUSION

As in the past, new technologies will in the future greatly enhance the ability of naval commanders at all levels to execute their numerous responsibilities much more effectively. But despite claims to the contrary, advanced automated decision aids cannot and will not replace the humans. Warfare at sea is a too complex and unpredictable activity to be taken over by machines. Only the human brain is fully capable of reacting timely and properly to sudden and unanticipated changes in the situation at sea and to successfully counter the enemy's actions and reactions. Yet a naval commander would considerably reduce the chances for success by either disusing or misusing automation.

NAFO

Notes:

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[3] John T. Nelsen, John T. "Where to Go from Here? Considerations for the Formal Adoption of Auftragstaktik by the US Army" (*Fort Leavenworth, KS: School of Advanced Military Studies, U.S. Army Command and General Staff College,* December 1986), pp. 7-8.

[4] Martin Blumenson, "Essence of Command: Competence, Iron Soul", *Army 3* (March 1993), p. 42

[5] Lothar Rendulic, *"Grundlagen militärischer Führung"* (Herford/Bonn: Maximilian Verlag, 1967), p. 50.

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